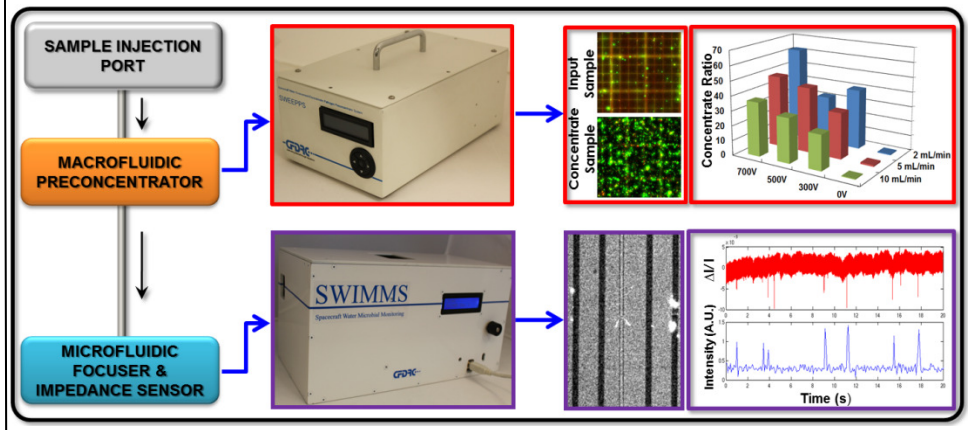
A Miniaturized Sensor for Microbial Monitoring of Spacecraft Water Environment

Topic: X2.03: Environmental Control and Life Support, Project No. NNX11CC08C

Identification and Significance of Innovation

- Presence of pathogenic microbes in closed spacecraft environment poses a significant risk to astronaut health and performance and compromises space exploration for extended periods
- Accurate microbial monitoring of water environment is of paramount importance to ensure proper functioning and control of the Life Support Systems (LSS)
- Currently available methods are bulky, consumable-hungry, time-consuming and labor-intensive and consequently, ill-suited for spacecraft deployment
- There is a need to develop an innovative microbial monitoring technique suitable for spacecraft water environment



Technical Objectives and Work Plan

Our overall objective is to develop (design, fabricate, test and demonstrate) a novel miniaturized, automated, label-free sensor for microbial monitoring in spacecraft water environment.

- A macrofluidic preconcentrator was developed to enrich microbe samples for improved detection sensitivity
- A micropore-based microfluidic focuser was developed to allow precise microbial manipulation
- A microfluidic impedance-based detector was developed to enable label-free detection and enumeration of the bacteria in the sample
- Optimized and refined hardware design and operating protocols were developed for enhanced performance
- System engineering and integration was performed for fully automated operation with minimal user intervention
- Extensive validation and demonstration was carried out using mixed waterborne bacterial samples of NASA interest over a long operating period (45 days)

Phase II End-product is at TRL 4-5

NASA Applications

The device will provide NASA a powerful tool for real-time microbial monitoring, and greatly aid in NASA's efforts to minimize microbial exposure/infection hazard, develop countermeasures, and ensure proper functioning and quality-control of life support system in spacecrafts, space shuttles and space stations. The device will be of direct use to NASA's ground-based research facilities and amenable for space deployment as well.

Non-NASA Applications

- Water monitoring in industrial facilities (e.g., wastewater treatment and food-processing)
- Water quality control in public settings (e.g., hospitals, drinking and recreational waters)
- Pre-clinical and clinical point-of-care diagnostics (pathogen detection in body fluids)

Firm Contacts

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